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### Citation for published version:

Bell, R, Haszeldine, R, Brownsort, P & Mackay, E 2017 'Clean Growth Strategy – Consultation Response: SCCS response to the UK Government consultation on the Clean Growth Strategy' SCCS Working Papers, no. WP SCCS 2017-08, SCCS, pp. 1-11. <<http://hdl.handle.net/1842/29502>>

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## **Clean Growth Strategy – Consultation Response**

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**SCCS response to the UK Government consultation on the Clean Growth Strategy**

**December 2017**

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Scottish Carbon Capture & Storage



# Clean Growth Strategy – Consultation Response

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## 1 Clean Growth Strategy: general comments

Scottish Carbon Capture and Storage (SCCS) welcomes the UK Government's Clean Growth Strategy, and its commitment to carbon capture and storage (CCS) as a means of reducing greenhouse gas emissions, particularly from industry, and as a means of stimulating economic growth. However, we have some concerns that the strategy does not reflect the urgency with which CCS needs to be progressed, and that the level of investment proposed will not be sufficient to support the development of this vital industry.

### 1.1 Importance of carbon capture and storage

- CCS is a set of technologies that can reduce emissions of carbon dioxide (CO<sub>2</sub>) at source to prevent increased atmospheric concentrations of the gas, which cause climate change.
- The capture, transportation and storage of CO<sub>2</sub> already takes place commercially, for example, in the drinks industry, fire extinguishers and reinjection into oil fields. CCS will deploy this knowledge at large scale for the purposes of climate mitigation.
- CCS is the only option that would enable deep emissions reductions for many energy-intensive and process industries, such as steel, cement, chemicals and refineries. It will thereby enable innovation and the retention of high-value jobs within Europe's high-carbon manufacturing industries.
- When CCS is used with sustainable biomass or air capture technology, it can provide "negative emissions", which actively reduce the stock of harmful CO<sub>2</sub> in the atmosphere.
- The deployment of CCS at commercial scale will reduce the overall costs of decarbonisation, and enable faster emissions reductions in line with scientific advice on the risks of climate change.

### 1.2 Role of CCS in reducing emissions

Climate science, interpreted by the Paris Agreement<sup>1</sup>, implies that a large-scale capability to avoid CO<sub>2</sub> emissions and to generate "negative emissions" will be needed well before 2050: CCS provides such a capability. Studies have repeatedly demonstrated that CCS is the least-cost option for decarbonising the UK economy<sup>2</sup>, and indeed that the Fifth Carbon Budget will be very difficult to meet without CCS<sup>3</sup>. Developing a CCS industry in the UK would be a cost-effective route to meeting our carbon targets as well as offering economic opportunities<sup>4</sup>.

The UK is unique in Europe for its capacity for geological storage of CO<sub>2</sub>, and there is a wealth of research which explores and maps this opportunity; there are also existing pipelines that could be

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<sup>1</sup> *The Paris Agreement*. UNFCCC, 2015: [http://unfccc.int/paris\\_agreement/items/9485.php](http://unfccc.int/paris_agreement/items/9485.php)

<sup>2</sup> *Lowest Cost Decarbonisation for the UK: The Critical Role of CCS*, Report to the Secretary of State for Business, Energy and Industrial Strategy from the Parliamentary Advisory Group on Carbon Capture and Storage (CCS), September 2016.

<sup>3</sup> *Meeting Carbon Budgets: Closing the policy gap*. Committee on Climate Change, 2016. <https://www.theccc.org.uk/wp-content/uploads/2017/06/2017-Report-to-Parliament-Meeting-Carbon-Budgets-Closing-the-policy-gap.pdf>

<sup>4</sup> Committee on Climate Change, 2016: <https://www.theccc.org.uk/wp-content/uploads/2016/07/Letter-to-Rt-Hon-Amber-Rudd-CCS.pdf>

repurposed to transport CO<sub>2</sub> to depleted oil and gas fields. Norway's 20 years of subsurface CO<sub>2</sub> storage demonstrates that geological storage is safe and feasible, and CCS partners continue to research options for monitoring CO<sub>2</sub> movement once stored.

The UK is estimated to have the capacity to store 78 gigatonnes of CO<sub>2</sub>, more than any other country in Europe<sup>5</sup> – for comparison, the UK's net CO<sub>2</sub> emissions in 2015 totalled 403.8 million tonnes.<sup>6</sup> The Government should therefore give more consideration to the needs and potential of a storage industry. The Lord Oxburgh report<sup>7</sup> recommended the creation of a CCS Delivery Company to manage construction and risk for early projects, deliver a transport and storage infrastructure that could be privatised when established, and could cut the cost of meeting UK climate targets by billions of pounds each year – we were surprised not to see this recommendation reflected in the Clean Growth Strategy, but hope that the CCUS\* Cost Challenge Task Force will revisit it.

### 1.3 Role of Clean Growth Strategy in deploying CCS

As acknowledged in the Clean Growth Strategy, the technology necessary to capture, transport and store CO<sub>2</sub> already exists, and the focus now needs to be on reducing the cost: this can be done by funding research, supporting CCS demonstration projects, and ensuring that existing North Sea infrastructure that can be repurposed for CO<sub>2</sub> transport is not decommissioned.

In the strategy, the Government states that it is “re-affirming our commitment to deploying CCUS in the UK subject to cost reduction”. We urge the Government to consider the cost of CCS in relation to a future carbon price that reflects the cost of remediating environmental and social loss and damage caused by climate change, rather than against a business-as-usual case in which the carbon price is low.

We also urge the Government to make the best use of the UK's resources by supporting the delivery of infrastructure needed to transport CO<sub>2</sub> to geological storage in the UK continental shelf. The UK has the potential not only to store its own CO<sub>2</sub> but to create an industry to store CO<sub>2</sub> from other countries. The UK Government should seek to make the most of the carbon storage resources available to it, rather than considering becoming a customer of another country.

The cost of CCS can be reduced by re-using existing infrastructure, such as oil and gas pipelines, and for this reason we urge the Government to pause the decommissioning of the Atlantic and Cromarty pipeline and Goldeneye pipeline and find an ownership model that allows these pipelines to be repurposed for the transport of CO<sub>2</sub> for geological storage. There is no mention in the strategy of infrastructure development, but decisions on the value of preserving useful on or offshore transport infrastructure need to be made quickly to avoid unnecessary costs in the future.

The UK has an immense CO<sub>2</sub> storage capacity and existing oil and gas infrastructure that could be repurposed to transport CO<sub>2</sub>,<sup>8,9</sup> so we welcome the government's ambition to have the option to

<sup>5</sup> CO<sub>2</sub> STORage Evaluation Database (CO<sub>2</sub> Stored). *The UK's online storage atlas*. Michelle Bentham, Tom Mallows, Jonathan Lowndes. *Energy Procedia*, Volume 63, 2014, Pages 5103-5113.

<http://www.sciencedirect.com/science/article/pii/S1876610214023558>

<sup>6</sup> 2015 UK Greenhouse Gas Emissions, Final Figures. BEIS, 2017.

[https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/604350/2015\\_Final\\_Emissions\\_statistics.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/604350/2015_Final_Emissions_statistics.pdf)

<sup>7</sup> *Lowest Cost Decarbonisation for the UK: The Critical Role of CCS*, Report to the Secretary of State for Business, Energy and Industrial Strategy from the Parliamentary Advisory Group on Carbon Capture and Storage (CCS), September 2016.

<http://www.ccsassociation.org/news-and-events/reports-and-publications/parliamentary-advisory-group-on-ccs-report/>

\* Carbon capture, utilisation and storage. Our understanding is that the market for utilisation of captured carbon dioxide is saturated, so the focus of government action should be on developing permanent storage, rather than new utilisation markets that may not have a long-term carbon reduction impact. In this response, we have used CCUS when quoting from or referring to the Clean Growth Strategy, but CCS when referring to the suite of technologies that we see as having a substantial, permanent and cost-effective impact on the UK's greenhouse gas emissions.

<sup>8</sup> *Progressing Development of the UK's Strategic Carbon Dioxide Storage Resource: A Summary of Results from the Strategic UK CO<sub>2</sub> Storage Appraisal Project*. Energy Technologies Institute, 2016. [https://s3-eu-west-](https://s3-eu-west-1.amazonaws.com/energy-technologies-institute/Strategic_CO2_Storage_Appraisal_Report.pdf)

deploy CCS at scale during the 2030s; however, a stronger funding commitment will be required in order to deliver the demonstration projects that will bring learning and cost reduction.

We are keen to work with the Government to identify and overcome the barriers to deploying CCS in the UK, and welcome the announcement of a CCUS Cost Challenge Task Force and a CCUS Council.

## 1.4 Value for money

We welcome the Government's recognition that there is a "new opportunity for the UK to become the global technology leader for CCUS". We note the three commitments, which underpin the consideration of CCUS in the Clean Growth Strategy (page 69):

- To reduce our emissions in the most cost-effective way
- To maximise innovation to develop world-leading technologies
- To seek the maximum possible benefits from investment for improving the productivity of the UK economy

These are similar to, but not the same as, the two guiding objectives of the UK's approach to reducing emissions (page 47):

- To meet our domestic commitments at the lowest possible net costs to UK taxpayers, consumers and businesses
- To maximise the social and economic benefits for the UK from this transition

We understand the Government's desire to achieve cost-effectiveness and to maximise economic benefits; at the same time, it must be recognised that the 80% emissions reduction target, and commitments flowing from the Paris Agreement, will have to happen at some point (and preferably sooner rather than later), and that this will inevitably come at a cost above business-as-usual.

The Lord Oxburgh report identified CCS as the lowest cost pathway for achieving emissions reductions for the UK, acknowledging that it will be expensive at first but that deployment will bring costs down. The report states that "UK action on CCS now will deliver lowest cost to the consumer. There is no justification for a delay. Heavy costs will be imposed on current and future UK consumers by a continued failure to enact an effective CCS policy."

We support the recommendations made in the Oxburgh report, and encourage the Government to take them up: this includes recognising that there needs to be state intervention, such as the establishment of a CO<sub>2</sub> transport and storage company (T&SCo) to incentivise uptake of industrial CCS, and to support the development of CO<sub>2</sub> transportation and storage infrastructure. As the report states, "UK industry does not have the incentive, scale or financial capacity to support the development of CCS infrastructure. A payment scheme will therefore be needed to give industrial emitters an incentive to collect their CO<sub>2</sub> and pay T&SCo to receive it from them. Such "Industrial Capture Contracts" will need to be funded directly by HMG."<sup>10</sup>

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[1.amazonaws.com/assets.eti.co.uk/legacyUploads/2016/04/D16-10113ETIS-WP6-Report-Publishable-Summary.pdf](https://1.amazonaws.com/assets.eti.co.uk/legacyUploads/2016/04/D16-10113ETIS-WP6-Report-Publishable-Summary.pdf)

<sup>9</sup> *Reducing costs of carbon capture and storage by shared reuse of existing pipeline – Case study of a CO<sub>2</sub> capture cluster for industry and power in Scotland*. Peter A. Brownsort, Vivian Scott, R. Stuart Haszeldine. *International Journal of Greenhouse Gas Control*. 52: 130-138. (2016).

<sup>10</sup> *Lowest Cost Decarbonisation for the UK: The Critical Role of CCS*, Report to the Secretary of State for Business, Energy and Industrial Strategy from the Parliamentary Advisory Group on Carbon Capture and Storage (CCS), September 2016. <http://www.ccsassociation.org/news-and-events/reports-and-publications/parliamentary-advisory-group-on-ccs-report/>

The third commitment, and the second guiding objective can also be met by CCS: a recent report by Summit Power sets out the benefits to the economy of a CCS industry, and the risks to the economy of delaying its development.<sup>11</sup> The study shows that the development of a UK CCS industry – focused on an East Coast network – could provide a total economic and societal benefit of £163 billion in the period to 2060, including £54bn of domestic economic activity with over 225,000 associated jobs and £9bn of positive balance of trade. It is also important to recognise the non-financial benefits of CCS, as explored in the study such as improvements to health and wellbeing.

## 1.5 Carbon dioxide utilisation

We are surprised that the Clean Growth Strategy has such strong emphasis on CO<sub>2</sub> utilisation when the UK has a clear strength in its opportunity for geological CO<sub>2</sub> storage under the North Sea. We consider that the strategy should focus on making the most of this resource, including charging to store other countries' CO<sub>2</sub>, rather than developing new markets for CO<sub>2</sub>.

Carbon capture and utilisation (CCU) can contribute to emissions reduction, but this is not automatically the case. Where the CO<sub>2</sub> is “locked up” in a new form, such as cement, it becomes a form of storage, but where it is used, for example, to carbonate drinks, then the utilisation simply delays the release of the CO<sub>2</sub>. Some utilisation processes also have an energy requirement, which is likely to have a carbon implication. Before providing support for a proposed CCU activity, we urge the government to assess its long-term climate mitigation potential using the widest boundaries for life-cycle analysis. If the activity cannot be shown to significantly reduce the amount of CO<sub>2</sub> entering the atmosphere, then we consider that the activity should not be funded under the Clean Growth Strategy.

Our understanding is that the market for CO<sub>2</sub> is saturated<sup>12</sup>: we recommend that the Government undertake research to understand if this is the case, and how big the market actually is (or could be). In any case, we expect that the amount of CO<sub>2</sub> available from carbon capture would far outweigh the CO<sub>2</sub> utilisation market, so there will still be the need for geological storage. For this reason, we suggest greater consideration is given to the question of whether it is appropriate to promote CCU above other forms of innovation in climate change mitigation.

## 1.6 CO<sub>2</sub> storage elsewhere

The Clean Growth Strategy states that the CCUS Cost Challenge Task Force's work will include “looking at the options for permanent storage of carbon dioxide [...] elsewhere via international shipping” (page 70). A prime candidate for this is Norway, where CCS technology has been operating for over 20 years and a state-supported programme of expansion is now under way<sup>13</sup>. Statoil has made it clear that it sees a future market for Norway in storing CO<sub>2</sub> for other states<sup>14</sup>.

We have previously expressed our concerns about the potential impacts of outsourcing the UK's CO<sub>2</sub> storage requirements to other countries.<sup>15</sup> This would be a short-sighted solution, which would relinquish the opportunity to use the UK's own resources to develop our own CO<sub>2</sub> storage industry.

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<sup>11</sup> *Clean Air - Clean Industry - Clean Growth: How carbon capture will boost the UK economy*. Summit Power, 2017.

<http://www.ccsassociation.org/news-and-events/reports-and-publications/clean-air-clean-industry-clean-growth/>

<sup>12</sup> Oxburgh (2016) p4: “CO<sub>2</sub> re-use, such as enhanced oil recovery and the production of materials such as building products, already exists and should continue to be encouraged, however the required large-scale decarbonisation of fossil fuels will create volumes of CO<sub>2</sub> which no market for re-use will be able to absorb.”

<sup>13</sup> Olav Skalmaraas, VP CCS Statoil, 2016: <https://www.cslforum.org/cslf/sites/default/files/documents/london2016/Skalmaraas-Sleipner-Workshop-Keynote-London0616.pdf>

<sup>14</sup> Trude Sundset, CEO Gassnova, 2017 “*Maybe we can turn the North Sea into a CO<sub>2</sub> storage hub for all of Europe*”: <http://www.nordicenergy.org/wp-content/uploads/2017/06/4-Trude-Sundset-Gassnova-Annual-Public-Workshop-2017-Stockholm.pdf>

<sup>15</sup> *Open letter to Claire Perry, Minister of State for Climate Change and Industry*. SCCS, September 2017. <http://www.sccs.org.uk/news/420-open-letter-to-claire-perry-minister-of-state-for-climate-change-and-industry>

The UK should not give up the opportunity to generate revenue from the sale of CO<sub>2</sub> storage services to other European states, or surrender any control of costs and availability of storage – this includes the cost of indemnification against liabilities for the stored carbon, which would doubtless be passed on to the UK by the storing country. With significant benefits to the UK economy at stake, we urge the government to avoid such a course of action and instead focus on supporting the development of CO<sub>2</sub> storage in the UK.

The Summit Power report, which examined the potential benefits of a UK CCS industry, also looked at a scenario where CO<sub>2</sub> is exported for storage in another country. It found “a reduction in GVA and jobs [...] however the biggest risk is of a negative balance of trade impact of around £97bn by 2060 based on [HM Treasury] carbon traded price futures (Central Case)”.<sup>16</sup> The report concludes that this means relying only on third-party countries to receive and store UK CO<sub>2</sub> moves GVA out of the UK and leaves it without control over its storage solution and the price it would ultimately pay.

This echoes SCCS’s own assessment of the benefits of developing a Scottish CO<sub>2</sub> hub.<sup>17</sup> The development of a UK CCS industry would enable the UK to export equipment and expertise, maintain high-quality jobs in the North Sea oil and gas sector and also provide a CO<sub>2</sub> management service to other European states, in parallel and in competition with the service likely to be offered by Norway.

Nationally controlled CO<sub>2</sub> storage would support rather than hinder the UK’s energy-intensive industries, and those with inherent process emissions of CO<sub>2</sub>, thereby giving them a robust economic future. It would also attract to the UK carbon intensive industries seeking to decarbonise their supply chain. It would also support the potential production and export of low-carbon hydrogen (using steam methane reforming (SMR) associated with CCS to remove production emissions) to Europe, a market that shows economic as well as environmental promise and one in which Norway is also interested.<sup>18</sup>

## 2 Detailed comments

### 2.1 CCS actions and commitments

In general, we support the actions and commitments included in the Clean Growth Strategy in relation to CCS. However, we have some comments and recommendations in relation to certain actions.

#### 2.1.1 Demonstrate international leadership in CCUS by collaborating with our global partners and investing up to £100 million in leading edge CCUS and industrial innovation to drive down cost

As stated previously, we are concerned that a focus on carbon utilisation rather than storage could reduce the effectiveness of the strategy in reducing greenhouse gas emissions, unless the utilisation options that receive the funding under this action are expected to result in permanent removal of CO<sub>2</sub> from the atmosphere.

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<sup>16</sup> *Clean Air - Clean Industry - Clean Growth: How carbon capture will boost the UK economy*. Summit Power, 2017. <http://www.ccsassociation.org/news-and-events/reports-and-publications/clean-air-clean-industry-clean-growth/> “There is a wide range of uncertainty over future carbon traded prices which means that balance of trade deficit could range from £160bn (high case) to £40bn (low case), making this approach inherently riskier.”

<sup>17</sup> *Scottish CO<sub>2</sub> Hub: A unique opportunity for the United Kingdom*. SCCS, 2016. [http://www.sccs.org.uk/images/expertise/reports/working-papers/WP\\_SCCS\\_2016\\_01\\_Scottish\\_CO2\\_hub.pdf](http://www.sccs.org.uk/images/expertise/reports/working-papers/WP_SCCS_2016_01_Scottish_CO2_hub.pdf)

<sup>18</sup> *Evaluation Conversion of Natural Gas to Hydrogen*. Statoil, 2017. <https://www.statoil.com/en/news/evaluating-conversion-natural-gas-hydrogen.html>



### **2.1.2 Work in partnership with industry, through a new CCUS Council, to put us on a path to meet our ambition of having the option of deploying CCUS at scale in the UK, and to maximise its industrial opportunity**

We support this action, and urge the government to ensure that the CCUS Council includes high-emitting industries (i.e. those that will benefit from CCS) as well as the CCS supply chain and the CCS research community.

### **2.1.3 Develop our strategic approach to greenhouse gas removal technologies, building on the Government's programme of research and development (R&D) and addressing the barriers to their long-term deployment**

We commend the emphasis on the research and development of methods that will reduce the cost of CCS and ensure secure CO<sub>2</sub> storage. We also consider that such R&D effort will be most effective at this stage if coupled with an actual industrial project, as has been the case in Norway. In light of the findings of the recent United Nations Environment Programme Emissions Gap Report, which suggests it will become "increasingly critical" beyond 2030 to have methods of removing CO<sub>2</sub> from the atmosphere to address the likely overshoot of carbon budgets<sup>19</sup>, we recommend that this objective be more clearly defined, and pursued with a clear sense of urgency.

### **2.1.4 Convene a CCUS Cost Challenge Task Force to deliver a plan to reduce the cost of deploying CCUS**

We would welcome more clarity about the role of the CCUS Cost Challenge Task Force in delivering the plan to reduce the cost of deploying CCUS: will the task force produce the plan or simply make recommendations to inform it? Where will the responsibility for implementing the plan sit?

### **2.1.5 Review the delivery and investment models for CCUS in the UK to understand how the barriers to deployment can be reduced and how the public and private sectors can work together to deliver the Government's ambition for CCUS**

We suggest that this review should take the Lord Oxburgh report as its starting point and consider the elements of CCS systems – capture, transportation and storage – as discrete projects with their own investment and business models.

### **2.1.6 Work with ongoing initiatives in Teesside, Merseyside, South Wales and Grangemouth to test the potential for development of CCUS industrial decarbonisation clusters**

We welcome this approach to decarbonising the UK's industrial regions. SCCS considers that this is an appropriate approach to developing a CCS industry and reducing greenhouse gas emissions from hard-to-decarbonise industries, while future-proofing them against an anticipated carbon price increase.

### **2.1.7 Participate in Mission Innovation and its Carbon Capture Challenge**

We agree that participation in Mission Innovation is important, as meeting climate change targets is a trans-boundary issue that also transcends the lifespan of individual administrations. However, we have some concerns over its focus on R&D, when what is needed for CCS is deployment. Allocation of funding through Mission Innovation should be supported by adequate signposting and civil service resource to ensure that it results in tangible progress on CCUS innovation or CCS deployment.

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<sup>19</sup> *The Emissions Gap Report 2017*. UNEP 2017, [https://wedocs.unep.org/bitstream/handle/20.500.11822/22070/EGR\\_2017.pdf?sequence=1&isAllowed=y](https://wedocs.unep.org/bitstream/handle/20.500.11822/22070/EGR_2017.pdf?sequence=1&isAllowed=y)

### **2.1.8 Develop closer collaborative working with countries such as Norway, the United States, Canada and Australia, including joint working on innovation and carbon dioxide transport and storage solutions**

We support this action and hope that it will build on existing work by government, academia and industry. The listing by the European Commission to identify Projects of Common Interest for a cross-border CO<sub>2</sub> network shows that the Netherlands is also a strategic partner, and that very substantial funds can become available from the EU to develop and then construct cross-border CO<sub>2</sub> transportation networks.<sup>20</sup> The UK's research institutes are already involved in such collaborations and will be able to inform and participate in this action.

### **2.1.9 Invest a further £10m in the international CCS programme**

International CCS capacity building is good, and certainly merits cash investment, but perhaps better value could be achieved by coupling cash investment with supporting expertise. The UK has invested in taking forward several projects to Front-End Engineering and Design (FEED), and the knowledge acquired during this process could usefully be shared internationally. We suggest that investment should be carefully focussed to have the greatest effect on actual deployment of CCS technology, although would point out that £10m is small in this context.

### **2.1.10 Organise an international Global Carbon Capture Usage and Storage Conference in 2018 with international partners**

Given Scotland's significant potential for CO<sub>2</sub> storage, the CCUS research work in Scotland's universities, and the projects that are currently being developed at St Fergus, Grangemouth and elsewhere, we suggest that this conference should be held in Scotland. SCCS has experience in delivering large events, and strong contacts with industry and academia both within and outside the partnership, so would be well placed to support the Government in delivering this action. The conference could be used to act as a UK leadership platform, with invited parties contributing to a CCS Declaration, in the same way that the UK and Canada acted on coal with the announcement of the Powering Past Coal Alliance. If the conference was timed for summer/autumn, this would enable strong leadership statements to be made at CoP 24 in Poland in December 2018.

### **2.1.11 Publish joint industrial decarbonisation and energy efficiency action plans with seven of the most energy intensive industrial sectors**

Two of these seven sector plans (for cement and oil refining) have an action to facilitate the deployment of CCUS in their sector; chemicals has a similar action, to "develop and implement a strategy to integrate smarter use of energy and feedstocks in the chemical sector with Industrial Carbon Capture, Usage and Storage".

The first three sub-actions for each of these are the same: two actions in each plan for BEIS to understand the current state of deployment of CCUS in the sector, and potential deployment opportunities; and a third for the industry body (Mineral Products Association, UK Petroleum Industry Association and Chemical Industries Association respectively) to raise public awareness of CCUS. These actions are useful but they leave a gap where there should be engagement with industrial plants and businesses themselves.

The plan for the chemicals sector has two additional sub-actions, relating to gathering and disseminating case studies, to help individual actors within the industry to engage with, and deploy,

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<sup>20</sup> [https://ec.europa.eu/energy/sites/ener/files/documents/annex\\_to\\_pci\\_list\\_final\\_2017\\_en.pdf](https://ec.europa.eu/energy/sites/ener/files/documents/annex_to_pci_list_final_2017_en.pdf)

CO<sub>2</sub> capture. We suggest that these last two sub-actions should be replicated for both the cement and oil refining sectors to make the action more effective.

The plan for ceramics includes a sub-action to consider CCS as a longer term (4-5 years) priority for the ceramics industry. It also aims to increase the use of bioenergy in the sector – we would recommend that any conversion to bioenergy should be accompanied by CCS to achieve negative emissions.

CCUS is not mentioned in the plans for food and drink, glass, or pulp and paper. We consider that this is a missed opportunity for the food and drink sector, many parts of which (such as brewing and distilling) generate relatively pure streams of CO<sub>2</sub>, which could be captured relatively easily and used to build a market for carbon storage. The storage of biogenic CO<sub>2</sub> from fermentation would contribute to negative emissions.

The emphasis for glass and pulp/paper appears to be on heat recovery, but although this might reduce the need for energy for heating elsewhere, it would not reduce the emissions from the sector. Carbon capture is compatible with waste heat recovery (and could, indeed, make use of the recovered heat), so we consider that it should have been included in these plans. Much of the heat for pulp/paper comes from the combustion of biomass, which could deliver negative emissions if resulting CO<sub>2</sub> is captured and stored. The high temperature requirements for glass could be met by a switch to hydrogen, if the plant was located in a cluster where SMR and CCS is being considered.

These are high-value, skilled jobs and supply chains, and we recommend that the Government creates sector deals for these industries in order to safeguard their contribution to the economy.

## **2.2 Other actions and commitments**

### **2.2.1 Setting up a Green Finance Taskforce to provide recommendations for delivery of the public and private investment we need to meet our carbon budgets and maximise the UK's share of the global green finance market**

The Green Finance Taskforce should work closely with the CCUS Cost Challenge Task Force to ensure that investment needs for CCS are taken into account. The work of the task force also needs to be closely aligned to the action to “review the delivery and investment models for CCS in the UK.”

### **2.2.2 Establish an Industrial Energy Efficiency scheme to help large companies install measures to cut their energy use and bills**

We urge the Government to ensure that the package of measures offered to industry under this action is consistent with wider emissions reduction efforts, particularly in areas where there is the potential for an industrial cluster approach to carbon capture.

### **2.2.3 Phase out the installation of high carbon forms of fossil fuel heating in new and existing businesses off the gas grid during the 2020s, starting with new build**

In addition to tackling off-grid businesses, there needs to be a strategic approach to low carbon heat across the housing stock, including consideration of hydrogen as a replacement for gas. As mentioned above, hydrogen can be produced through SMR which, if combined with CCS, provides a low-carbon fuel; in future, excess electricity from renewable generation can be used to produce hydrogen through electrolysis, avoiding CO<sub>2</sub> emissions altogether.

#### **2.2.4 Invest around £162m of public funds in research and innovation in Energy, Resource and Process efficiency, including up to £20m to encourage switching to lower carbon fuels**

Improvements to process and resource efficiency should consider how best to avoid or minimise waste products. This includes CO<sub>2</sub>, either emitted from fossil fuel combustion or as an unavoidable part of an industrial process itself, and as such this action should include investment to support CO<sub>2</sub> capture for industry.

This action should also consider the potential for industries to use hydrogen rather than fossil fuels.

#### **2.2.5 Phase out the installation of high-carbon fossil fuel heating in new and existing homes currently off the gas grid during the 2020s, starting with new homes**

In addition to tackling off-grid homes, there needs to be a strategic approach to low-carbon heat across the housing stock, including consideration of hydrogen as a replacement for gas.

### **3 Scottish Carbon Capture and Storage**

Scottish Carbon Capture and Storage (SCCS) is the largest Carbon Capture and Storage (CCS) research group in the UK. It is a partnership of the British Geological Survey, Heriot-Watt University, the University of Aberdeen, the University of Edinburgh and the University of Strathclyde working together with universities across Scotland. SCCS is funded by the Scottish Funding Council (SFC) and the Scottish Government.

Our mission is enabling carbon dioxide (CO<sub>2</sub>) emissions reduction through carbon capture and storage research and knowledge exchange

SCCS researchers and the supporting delivery team work with academics, business, industry, the public, regulators and policymakers worldwide to undertake research and facilitate dialogue towards CO<sub>2</sub> emissions reduction. A recognised centre of excellence, we provide independent and trusted advice to address the global challenge of climate change through economically robust CCS solutions.

SCCS represents significant expertise in carbon capture, transportation and storage technology, as well as social perceptions, environmental impact, law and petroleum economics.